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(54) Title: SHELL FOR BALLISTIC HELMET

(57) Abstract: A shell for ballistic helmet formed from a plurality of paraaramide fabric layers such as KEVLAR-KM2®, and bonding resin. All fabric layers have areal density less than 200g/m², preferably part of them have areal density less than 160g/m². The number of paraaramide layers is greater than 28, preferably 38 and more. The bonding resin constitutes less than 12% of the shell weight. The shell has average thickness less than 6.5 mm and average areal density less than 7.5 Kg/m². A method for the production of such shells includes pressing and bonding the plurality of layers at pressure equal to or above 150Kg/cm², preferably above 300Kg/cm².

SHELL FOR BALLISTIC HELMET

FIELD OF THE INVENTION

This invention relates to shells for ballistic helmets, and more particularly to helmet shells made of paraaramide fabrics such as Kevlar®, protecting from bullets and fragments.

BACKGROUND OF THE INVENTION

A shell for ballistic helmet is supposed to stop incident shrapnel fragments or bullets, thereby protecting the head of the user. The aim of shell design and manufacture is to obtain a shell providing required ballistic protection at minimal weight. The weight of the shell is of great importance because the helmet user carries it for long periods of time, and the lighter the helmet, the more it is convenient in use.

The ballistic protection of the helmet is normally tested by the so-called V50 test, 17 grain, according to known US and European standards. The test measures the velocity at which 50% of fragments pierce the helmet while 50% are retained. An average areal density of the shell material is the weight of the shell divided by its area. The ratio between the level of ballistic protection and the areal density is the decisive parameter determining the helmet quality, and in general if it is higher, then the helmet is better. This ratio is called protection coefficient:

Protection coefficient = V50/areal density

An additional parameter is the thickness of the shell. The smaller the thickness, the less awkward is the helmet and more convenient it is in usage.

One of the most common technologies for production of ballistic helmet shells is pressure forming of the shells in a mold, from a stack of paraaramide

fabric blanks with bonding resin. The manufacturers are known to use up to 16-24 layers of fabric with 220 to 300 g/m² areal density, and bonding resin in about 14-20% of the total shell weight. The stack of blanks soaked with resin is pressed in a mold at about 30-40 Kg/cm² pressure at temperature suitable for the resin polymerization. The obtained shells have more than 8-9 Kg/m² areal density, 7.5-9 mm thickness, and the shell weight is not less than 0.850 Kg.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a shell for ballistic helmet formed from a plurality of paraaramide fabric layers and bonding resin. The fabric layers have areal density less than 200g/m², the shell has average thickness less than 6.5 mm and average areal density less than 7.5 Kg/m². Preferably, part of the fabric layers have areal density less than 160g/m², while the rest fabric layers have areal density between 200 and 160g/m². The number of paraaramide layers should be greater than 28, preferably not less than 33, more preferably 38 and more, at least part of the layers having areal density not exceeding 160g/m².

Preferably, the bonding resin constitutes less than 12% of the shell weight.

The present invention is based on a surprising discovery of the inventors that, if in a shell for a ballistic helmet formed from a plurality of paraaramide fabric layers and bonding resin, considerably greater number of layers is used than that known heretofore with a lower areal density (weight) of the layers than that typically used in the practice, the shell yields the required ballistic protection at lighter weight than conventional helmet shells, or better ballistic protection with the same shell weight. Another contributing factor is the usage of layers with different areal density.

According to another aspect of the present invention, there is provided a method for the production of shells for ballistic helmets from a plurality of layers as

described above, the method including pressing and bonding the plurality of layers at pressure equal to or above 150Kg/cm², preferably above 300Kg/cm².

The composition and method of production according to the present invention provide for lighter helmets with better ballistic protection qualities. For example, a shell with less than 0.7 Kg weight and level of protection higher than V50 = 2000 ft/sec can be manufactured.

DETAILED DESCRIPTION OF THE INVENTION

One example of the material used for the production of a shell according to the present invention is a material made of 38-40 layers of KEVLAR®-KM2 and/or other paraaramide fabric having areal density respectively 155g/m² and 195g/m² and bound by bonding resin of about 10-12% of the shell weight. The KEVLAR®-KM2 fabric is used mainly in the external layers of the shell.

The above shell structure is manufactured by pressing the stack of blanks to 6 mm thickness using pressures of 150 to 300Kg/cm².

A prototype ballistic helmet shell with the inventive structure, manufactured by the above method weights 0.7 Kg and provides for level of protection V50 = 2000 ft/sec. The area of the shell is about 0.1 m². The average areal density of the shell is 0.7/0.1 = 7 Kg/m², and the protection coefficient is 2000/7 = 286.

CLAIMS:

1. Shell for ballistic helmet formed from a plurality of paraaramide fabric layers and bonding resin, wherein said fabric layers have areal density equal or less than 200g/m², said shell has average thickness less than 6.5 mm and average areal density less than 7.5 Kg/m².

2. Shell according to Claim 1, wherein at least one of said fabric layers has areal density less than 160g/m².

3. Shell according to Claim 1, wherein part of said fabric layers have areal density less than 160g/m² and the rest fabric layers have areal density between 200 and 160g/m².

4. Shell according to Claim 2, wherein part of said paraaramide fabric layers are KEVLAR-KM2®.

5. Shell according to Claim 1, wherein said bonding resin constitutes less than 12% of the shell weight.

6. Shell according to Claim 1, wherein said plurality of layers is greater than 28.

7. Shell according to Claim 6, wherein said plurality of layers is not less than 33.

8. Shell according to Claim 7, wherein said plurality of layers is not less than 38.

9. Shell for ballistic helmet formed from a plurality of paraaramide fabric layers and bonding resin, wherein said plurality of layers is greater than 28 and said shell has average thickness less than 6.5 mm.

10. Shell for ballistic helmet formed from a plurality of paraaramide fabric layers and bonding resin, wherein said plurality of layers is not less than 38.

11. Shell for ballistic helmet formed from a plurality of paraaramide fabric layers and bonding resin, wherein said fabric layers have areal density less than 200g/m², and said plurality of layers is greater than 28.

12. Shell for ballistic helmet formed from a plurality of paraaramide fabric layers and bonding resin, wherein said plurality of layers is greater than 28 and said shell has average areal density less than 7.0 Kg/m².

13. Method for production of shell for ballistic helmet according to anyone of the preceding claims, including pressing and bonding of said plurality of layers at pressure equal or above 150Kg/cm².

14. Method according to Claim 12, wherein said pressure is equal or above 300Kg/cm².

INTERNATIONAL SEARCH REPORT

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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

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Y	page 1, line 7,11,22,23 page 2, line 25-30 page 3, line 15-29 page 4, line 11-14,23,24,27-32 page 5, line 9 -page 6, line 22	5
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A	abstract column 1, line 8-11,19,20 column 2, line 8-11 column 3, line 19-24,34-36 column 4, line 20-43	1

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Menier, R

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